

# *Santa Cruz Island Primary Restoration Plan*

## *CHAPTER ONE* **PURPOSE AND NEED**

### *Introduction*

The National Park Service (NPS) and The Nature Conservancy (TNC) have long considered the most critical management actions needed to achieve primary restoration of Santa Cruz Island to be: a) eradicate feral sheep, b) eradicate feral pigs, and c) control fennel. Feral sheep were eradicated from TNC property during 1984-87. The National Park Service concluded an intensive 3-year effort to remove sheep from Santa Cruz Island. This effort has successfully removed approximately 9,270 sheep from the island. At publishing time of this document it is believed that Santa Cruz Island is sheep-free, however, vigilant monitoring for remaining sheep is on-going. Substantial and unaided recovery of native vegetation communities occurred following removal of sheep from TNC property. However, many native habitats and species continue to be severely impacted by feral pigs, fennel, and other non-native plant species.

The presence of feral pigs greatly facilitates the spread of fennel and other invasive weeds. Pig rooting causes massive destruction of native species and leaves bare ground that can be easily colonized by weeds. The removal of non-native pigs will greatly reduce the spread of non-native

plants and result in substantial natural recovery of native island resources.

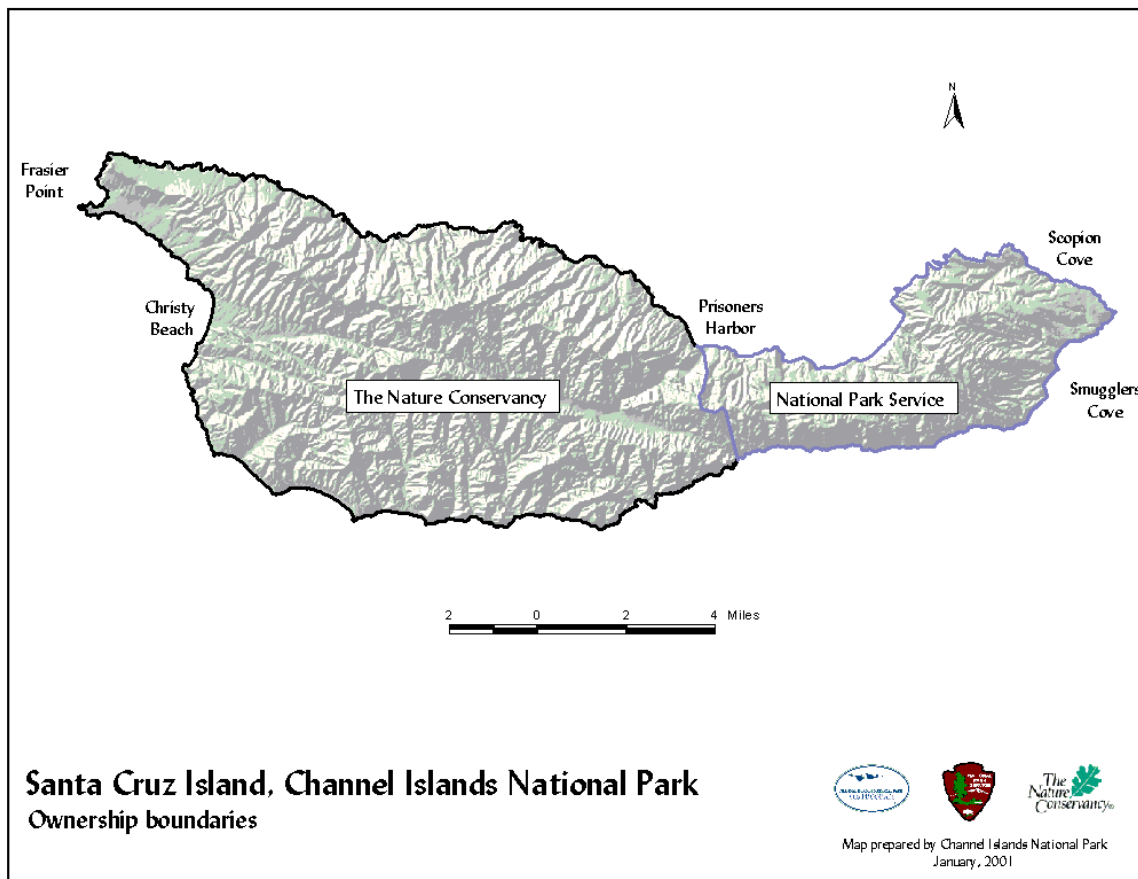
### *Ownership*

The ownership of Santa Cruz Island is divided between the NPS and TNC. NPS owns the eastern 24% of the island (ESCI); TNC owns the western 76% of the island (C/WSCI). (Figure 1).

All of Santa Cruz Island is within the boundaries of Channel Islands National Park (Figure 2). The Park's enabling legislation recognizes the value and appropriateness of achieving park goals through projects anywhere on the island and authorizes the use of federal funds on privately held portions of the park in order to protect and restore valuable resources.

The NPS and TNC share similar mandates for the conservation and protection of natural resources. The mission of Channel Islands National Park is to protect the nationally significant natural, cultural, scientific, and scenic values of the Channel Islands and adjacent marine waters and to provide present and future generations appropriate opportunities to experience and understand park resources. The Nature Conservancy, a private non-profit

Figure 1: Santa Cruz Island Ownership Boundaries



conservation organization, is committed to preserving sustainable ecosystems that maintain and enhance native biological diversity (The California Nature Conservancy 1997).

### *Guidance for Resource Management*

The 1916 NPS Organic Act, (16 USC 1 et seq.) directed that NPS lands be managed to conserve the resources contained within “in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” The Redwoods Act of 1978 (16 USC 1a-1) reaffirmed this principle. In general, these two statutes confer upon the Secretary of

the Interior the discretion to determine how best to protect and preserve park resources.

Since the establishment of Yellowstone National Park in 1872 and the subsequent formation of the National Park Service in 1916, the philosophy of natural resources management has evolved. Simple concepts such as protection of wildlife from poaching gradually gave way to recognition of the complexities of comprehensive ecosystem management in a regional and global context (NPCA 1989).

In 1961, the Secretary of the Interior convened a blue-ribbon panel to evaluate how NPS should manage large mammals and other animals. The resultant report (Leopold et al. 1963) clearly directed NPS toward *ecosystem management*, which is the management of all components of an ecosystem as a whole, rather than single species management. The Leopold

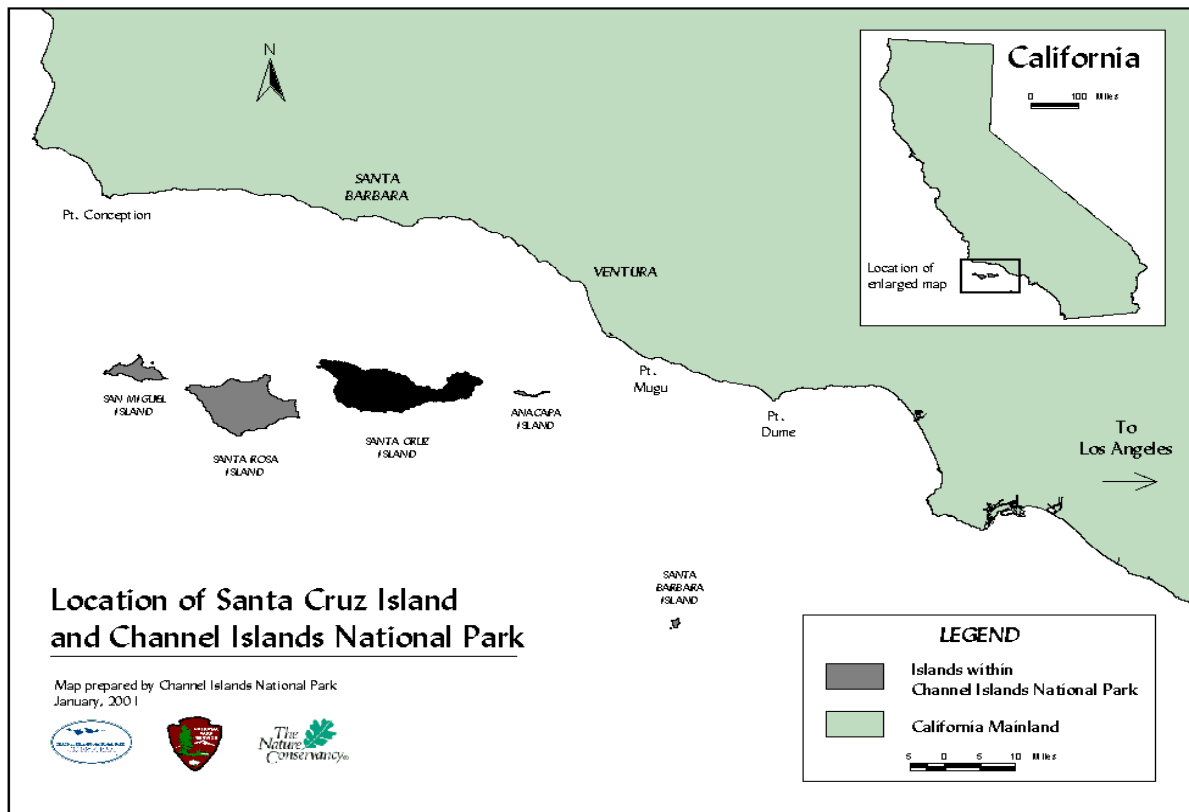
Commission promoted the notion that national parks should be managed as “vignettes of primitive America” in order to preserve, to the extent possible, the biota that existed or would have evolved had European humans not colonized North America. Although this has been interpreted by some as a call for “hands-off” management of a static primitive condition or scene, the Leopold Commission actually promoted an aggressive stewardship of parklands with “hands-on” management techniques, and perpetuation of dynamic, evolving ecosystems. For example, the report called for restoration of natural fire regimes in parks.

More recent work has built upon the findings of the Leopold Commission regarding resources management in NPS parks. Parsons et al (1986) states that the principal aim of National Park Service resource management in natural areas is the unimpeded interaction of

native ecosystem processes and structural elements. Parks should protect not only structural elements such as plants, animals, soil, water, and air, but also dynamic ecosystem processes such as natural fire, biotic evolution, and nutrient cycling.

In 1989, NPS again convened a blue-ribbon panel to assess the role of resource management and research in the future of national parks. The resulting report (NPCA 1989) validated findings of the Leopold Commission, affirming that the focus of park management should be to maintain or restore native biota and ecosystems and to resist establishment of alien, non-native organisms. Where possible, ecosystem management should attempt to preserve natural processes operating at a scale consistent with the evolution of the ecosystem being managed. The report recommended that NPS move well beyond static scene management to provide stewardship for the elements and processes

Figure 2: Vicinity Map Santa Cruz Island



contained in parks.

National Park Service management policies (NPS 1988) also reflect the development of ecosystem management concepts. In part, the policies state that natural resources should be managed with a concern for fundamental ecological processes as well as for individual species and features:

Managers and resource specialists will not attempt solely to preserve individual species (except threatened or endangered species) or individual natural processes; rather they will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity and ecological integrity of the plants and animals (NPS 1988).

Guidelines for management of species federally listed as threatened, endangered or candidates for listing are found in NPS management policies and natural resources management guidelines. National Park Service management policies (NPS 1988) and guidelines for natural resources management (1991) establish the affirmative responsibility of NPS, and the individual park, for managing both listed and candidate species. They also stress that management actions should emphasize removal of threats, but also include active recovery efforts, and that management should be done in an ecosystem context.

The Channel Islands National Park General Management Plan (1985) identified the need to remove exotic animals from Santa Cruz Island.

The Endangered Species Act requires that actions authorized, funded, or carried out by Federal agencies not jeopardize the continued existence of listed species. Under section 7(a)(2) of the ESA (16 USC section 1536), federal agencies are required to consult with the U.S. Fish and Wildlife Service (USFWS) on actions which may affect listed species or critical habitat. Because this primary restoration plan proposes actions that could affect the 9 federally

listed plant species on Santa Cruz Island, NPS will confer with USFWS on likely effects to those species.

National Park Service management also seeks to preserve and foster appreciation of cultural resources in NPS' custody through appropriate programs of research, treatment, protection, and interpretation (NPS 1988). Guidance for cultural resources management in NPS units is found in National Park Service Management Policies (1988) and Cultural Resource Management Guidelines (NPS-28). Management of cultural resources in NPS units is subject to the provisions of the National Historic Preservation Act (16 USC 470 et seq.), the National Environmental Policy Act (42 USC 4371 et seq.), the American Indian Religious Freedom Act (42 USC 1996), the Advisory Council on Historic Preservation's regulation regarding "Protection of Historic Properties" (36 CFR 800), the Secretary of the Interior's "Standards and Guidelines for Archeology and Historic Preservation (FR 48:44716-40) and "Federal Agency Responsibilities under Section 110 of the National Historic Preservation Act" (FR 53:4727-46).

## *Purpose and Need*

### *Purpose*

The purpose of the Santa Cruz Island Primary Restoration Plan is to protect the unique natural and cultural resources of the island from continued degradation and to initiate recovery of the island ecosystem by:

Eradicating feral pigs island-wide

Controlling fennel

## ***Need for Action***

These actions are necessary in order to:

Protect and initiate restoration of native plant communities

Protect rare plant species

Control and reduce the spread of invasive, non-native weeds, such as fennel, *Foeniculum vulgare*.

Protect island foxes through removal of the non-native food source (feral pigs) supporting non-native golden eagles

Conserve archeological sites threatened by accelerated erosion and pig rooting

Initiate conservation and restoration of soil resources

Invasions by non-native plant and animal species are generally considered to be one of the greatest threats to global biological diversity (Shafer 1990, Soule 1990). These invasions have been described as a “biological wildfire” (Federal Interagency Committee for the Management of Noxious and Exotic Weeds, 1998). Many examples exist demonstrating the negative impacts of non-native animals and plants on native biota. At the population level, native species can undergo a reduction in recruitment, distribution and abundance (Vitousek 1990), or be driven to extinction (Savidge 1987). At the community level, invasions can radically alter the structure and composition of native plant and animal communities (MacDonald and Frame 1988), and at the ecosystem level they can alter nutrient cycles, fire regimes, and other processes (D'Antonio and Vitousek 1992, Singer et al. 1984).

Ranchers and previous landowners of Santa Cruz Island have tried unsuccessfully to eradicate pigs since their introduction almost 150 years ago. Marla Daley, an expert on Santa Cruz Island history, reported (1999) that multiple efforts to eradicate feral pigs have been

undertaken by previous landowners using such varied methods as roping, spearing, and the release of the disease - hog cholera. In addition, island scientists have unanimously called for the eradication of feral pigs at the earliest possible date (Brumbaugh 1980, Van Vuren 1981a, Van Vuren 1981b, Hochberg et al. 1980, Baber 1982, Laughrin 1982, Collins 1987, Arnold 1999, Glassow 1999) due to documented impacts to natural and cultural resources. Institutions, agencies, and individuals with long-term associations with Santa Cruz Island have indicated their support for the need of a feral pig eradication program (Coblentz 1988, Ehorn 1988, Laughrin 1988, Power 1988, Van Vuren 1988, Young 1988).

## ***Restoration of native plant communities***

The Channel Islands of California are vivid examples of the pervasive impacts that non-native species can have on ecosystems. The most severe impacts to the island chain have been due to exotic animals, especially cattle, feral sheep, goats, and pigs (Brumbaugh et al. 1980, Minnich 1980). In addition to the impacts from feral and domestic livestock, many species of non-native plants have become established and dominate most of the island chain's vegetation communities. Non-native plants now comprise between 20-48% of the species on the islands, and between 25-80% of the ground cover (Halvorson 1992, Junak et al. 1994, and Klinger in prep).

## ***Protection of listed plant species***

In 1997 the U.S. Fish and Wildlife Service (USFWS) listed nine plant species on Santa Cruz Island as threatened or endangered. Rooting and grazing by feral pigs was a factor in the decline of each of these species. The Recovery Plan for Thirteen Plant Taxa from the Northern Channel

Islands (UFWS 2000) recommends development and implementation of an ...

... island-wide pig removal plan to prevent the continuing habitat degradation on Santa Cruz Island. The National Park Service should collaborate with The Nature Conservancy and other California Island managers to develop methods that will expedite the elimination of pigs from all of Santa Cruz Island.

Countless resource scientists, including a group of 20 land management professionals convened on SCI in 1998, have made similar recommendations.

### ***Reduce spread of non-native weeds***

The spread of many non-native weed species, such as fennel, is greatly facilitated by the transport of their seeds by animals and the presence of bare, unvegetated ground. Feral pigs spread non-native weeds through two basic mechanisms. Pigs feed on the seed heads of annual exotic grasses, fennel, and other weeds. The seeds emerge from the pig's digestive system intact and able to sprout. Pigs also carry seeds in their coats, having the ability to transport seeds many miles from the source point. Further, the rooting of pigs removes vegetative cover and creates bare ground for establishment of weedy plants.

### ***Protection of the Island Fox***

The island fox (*Urocyon littoralis*) is endemic to the California Channel Islands. The fox exists as a different subspecies on each of the six islands (Wayne et al. 1991, Collins 1993). It is distributed as six island populations each varying in size from less than a hundred to a few thousand individuals. Due in part to its

limited distribution and small numbers, the island fox has been listed as a threatened species in California (California Department of Fish and Game 1987) and is being considered for listing as a federally threatened or endangered species.

The island fox population on San Miguel has declined sharply from levels in 1993 (Coonan et al. 1998) with the adult population falling from 450 in 1994 to 15 in 1999 (Coonan et al., in prep). Monitoring data from Santa Cruz Island and survey data from Santa Rosa Island indicate that island foxes are undergoing similar catastrophic declines on those islands as well.

The catastrophic decline of island foxes appears to be due to predation by non-native golden eagles (Roemer et al. in prep.). The primary year-round food source that sustains the golden eagles is the piglets on Santa Cruz Island. The park is currently attempting to live capture and remove golden eagles from the northern islands. However, until the food source provided by piglets is removed, golden eagles will continuously re-establish populations on the island and prey on island foxes.

### ***Protection of archeological sites***

Santa Cruz Island contains a rich archeological record of the Chumash culture contained in some 3,000 sites, with the earliest dating nearly 9,000 years ago. Sites range from isolated artifacts to huge, stratified sites spanning a period of 8,000-9,000 years. The large number, diversity and relatively undisturbed nature of the island sites provide excellent research opportunities for archeological investigations into human adaptation in a context of changing environments and cultural conditions. Ninety percent of the island is listed in the National Register of Historic Places for its archeological significance. The remaining ten percent of the

island is eligible for listing in an expanded archeological district.

Feral pig rooting has damaged a large number of the island sites. Pig rooting to a depth of three feet has been noted in a number of sites. The information potential of some shallow sites and surface scatters has been completely destroyed by pig rooting. Rooting in the upper layers of deeper, more complex, stratified sites profoundly disturbs time and spatial relationships and destroys the context of the information contained in these sites. In addition, pig rooting has disturbed prehistoric and historic period burials found in many locations on the island. Continued pig rooting of archeological sites on the island will result in their loss of integrity, and ultimately loss of the values which make the Santa Cruz Island archeological district eligible for inclusion in the National Register of Historic Places.

### ***Conservation of soils***

The long history of grazing by non-native ungulates has greatly accelerated erosion of soils on Santa Cruz Island. Large areas have been denuded of vegetation and are eroded down to bedrock. Rooting by pigs exposes substantial sections of land to erosion by water and wind. Erosion and rooting cause disturbance to archeological sites that have long been protected by vegetation (Glassow and Arnold, pers. comm. 1999).

### ***Scope of the Proposed Action***

This document focuses on the concrete and immediate steps that must be taken to reverse the environmental degradation of Santa Cruz Island. The scope of the proposed action is to

fully eradicate feral pigs from SCI and to implement significant fennel control measures. These two actions have been determined to be the two most important actions that can be implemented in order to abate on-going resource degradation and recover unique island resources.

The restoration actions proposed in this document will require a major commitment of resources. It is recognized that additional intervention will be required in the future to ensure the full protection and recovery of island resources.

There are many management issues that are outside of the scope of this document. These issues will be dealt with in other plans:

- Long-term visitor facilities and opportunities
- Recovery of listed or rare plant species
- Use of fire as a restoration tool
- Recovery of island fox
- Changes to island infrastructure
- Bald Eagle Reintroduction

### ***Decisions to be Made***

For this DEIS, the official responsible for choosing the management action is the National Park Service Regional Director, Pacific West Region. The Regional Director, once the Final EIS has been completed, can decide to:

Select one of the alternatives analyzed within the Final EIS, including the No-Action alternative; or,

Modify an alternative (for example, combine parts of different alternatives), as long as the environmental consequences of the modified action have been analyzed within the Final EIS.

Factors the Regional Director will take into consideration in making a decision are:

- Does the alternative meet National Park Service guidelines and policies, including the Channel Islands General Management Plan?
- How well does the alternative meet the “Purpose and Need” for this project?
- How does the alternative respond to and/or resolve the environmental issues raised for this project?
- The nature and extent of public comment to the DEIS



# *Santa Cruz Island Primary Restoration Plan*

## *CHAPTER TWO* **ALTERNATIVES**

### *Introduction*

This chapter describes the four alternatives to be considered for implementation and identifies the significant environmental issues used to formulate these alternatives. The environmental issues were developed as a result of extensive “scoping” conducted for this analysis. The “scoping” actions that were conducted for this analysis are described in detail in Chapter Five “Consultation and Coordination”. This Chapter concludes with a section that explains the rationale for dismissing other methods or alternatives from consideration, and a comparison of alternatives.

### *Alternative Development Process*

Section 102(e) of NEPA states that all Federal agencies shall “study, develop, and describe appropriate alternatives to recommend courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources”. In addition to responding to unresolved conflicts, an EIS must “rigorously explore and objectively evaluate all reasonable alternatives” [40CFR 1502.14(a)].

Taken together, these requirements determine the range of alternatives and provide the basis for the Deciding Official’s informed decision, as required under NEPA. The Proposed Action, described in Chapter 1, was the result of a resource analysis done by NPS and TNC resource management staff in collaboration with pig and fennel control experts. This collaborative effort identified management actions necessary to respond to feral pig and non-native fennel impacts to the Santa Cruz Island ecosystem.

The alternatives detailed below were developed to focus on the issues identified by resource specialists within the NPS and TNC, pig and fennel control experts, university/academic experts, government regulatory agencies, and the general public. Chapter Five – Consultation and Coordination lists all individuals, agencies and organizations that provided substantive input regarding the proposed action.

### *Internal Scoping and Public Involvement Process*

The NEPA “scoping” process [40CFR 1501.7] was used to determine the scope of the analysis and to identify potential issues and opportunities related to the Proposed Action. A complete summary of the scoping and public

involvement process for the proposed project is summarized in Chapter Five.

## ***Significant Environmental Issues***

Through the Scoping and Public Involvement Process some significant environmental issues were identified. Significant issues are those that may require project-specific alternatives, mitigation measures or design elements to address the potential effects of the proposed activities.

For clarification, a summary statement that defines the scope of the issue for this project will accompany the identified issues. In addition, for each issue, measurement indices are given to provide a preview of how the issue will be evaluated for direct, indirect, and cumulative effects for each alternative. The “Issue” categories are as follows:

- **Issue 1: Likelihood of Success**
- **Issue 2: Impacts to Vegetation, including Weeds and Threatened and Endangered Plant Species**
- **Issue 3: Impacts to Island Fauna**
- **Issue 4: Impacts to Physical Resources including Soils, Water and Air Quality**
- **Issue 5: Impacts to Social Factors including Cultural Resources and Human Use**

### ***Issue 1: Likelihood of Success***

Efficacy for this analysis is defined as how well the alternative would meet the purpose and need; i.e., how well the alternative would protect the unique natural and cultural resources of Santa Cruz Island by eradicating feral pigs and controlling fennel.

#### *Measurement Index*

- Likelihood of achieving Island-wide eradication of feral pigs

### ***Issue 2: Impacts to Vegetation, including Weeds and Threatened and Endangered Plant Species***

Limited impacts to vegetation would occur as a result of implementing the proposed activities. However, in the long-term, native vegetation will benefit from the eradication of feral pigs and control of fennel. The effects analysis will identify the short-term impacts as well as the expected long-term benefits of implementing the proposed activities.

#### *Measurement Indices*

- Health of Threatened and Endangered Species
- Extent of Fennel
- Extent of Other Weed Species

### ***Issue 3: Impacts to Island Fauna***

Introduction of non-native flora and fauna to the Channel Islands has disrupted the ecology on all islands. The largest perturbations to Santa Cruz Island have been the introduction of sheep, pigs, and the highly invasive fennel. Sheep are no longer present on Santa Cruz Island, however abatement of feral pigs and invasive weeds would greatly affect island fauna in a beneficial way. The environmental effects section will focus on the following Santa Cruz Island fauna:

#### *Measurement Indices*

- Health of Native Island Fauna
- Non-Native Pigs

### ***Issue 4: Impacts to Physical Resources including Soils, Water and Air Quality***

Livestock grazing for 150 years on Santa Cruz Island has affected soil resources and water quality. The effects analysis will focus on watersheds of Santa Cruz Island and how loss of vegetation cover, direct soil disturbance, and vegetation type conversion, all impact runoff, soil erosion, and stream degradation/aggradation.

The prescribed fennel burn would create smoke which could result in haze and other contaminants being disseminated into the air.

#### Measurement Indices

- Soil Disturbance and Erosion
- Watershed level impacts
- Landtype and geomorphology (Water Quality)
- Smoke impacts (Air Quality)

#### ***Issue 5: Socioeconomic Impacts including Cultural Resources and Visitor Uses***

Cultural resources are non-renewable resources. As such, federal regulations have been passed which prohibit the destruction of significant cultural sites. Significant cultural properties do exist on Santa Cruz Island. The effects analysis will focus on how implementation of each alternative may affect cultural resources on the island.

Visitor use of Santa Cruz Island is different depending on the landowner. Visitor use is accommodated on National Park Service owned lands and is restricted on TNC owned lands. Access by visitors, TNC personnel, Park Staff, and researchers may be restricted or altered in certain areas during implementation activities.

#### Measurement Indices

- Prehistoric Cultural Resources
- Historic Cultural Resources
- Human Uses

#### ***Mandatory Topics and Dismissal of Issues***

As required under NPS Directors Order 12, this analysis must address twelve mandatory topics. Listed below are topics that must be addressed followed by a discussion on whether they are relevant to the analysis.

- a) Conflict with land use plans, policies or controls – The Park’s General Management Plan, as well as the Park’s Resources Management Plan identified the need to remove pigs from the Santa Cruz Island. The proposed action does not conflict with local, state, or tribal policies or regulations.
- b) Energy requirements and conservation potential – Santa Cruz Island like all of the Northern Channel Islands do not have electric or gas utilities supplied to them. The Park’s administration of these islands always emphasizes energy conservation. For instance all housing on the island are totally self sufficient for electricity through the use of solar energy. Significant energy demands may be necessary to transport people, equipment, and supplies to support the operation. Transportation occurs mainly by boats provided by the Park.
- c) Natural or depletable resource requirements and conservation potential – Resource requirements for undertaking this project would be to primarily supply the operation. Waste of resources is not an issue with operations that occur on the island. The expense of re-supplying a remote island ensures conservation of available resources.
- d) Urban quality, historic and cultural resources – Impacts to these resources can be found in Chapter Four - Impacts to Human Uses.
- e) Socially or economically disadvantaged populations – This proposed project would not change the local population’s work, recreation, or social interactions. As such

Executive Order 12898 (environmental justice) does not apply to this analysis.

- f) Wetlands and floodplains – No development will be occurring in wetlands or floodplains as part of this analysis.
- g) Prime or unique agricultural lands – Santa Cruz Island since the early 1800's has been used for rangeland for domestic livestock. Current ownership emphasizes land use conservation over agricultural use. Since no current agriculture practices are occurring on the island no impacts would occur to agricultural lands.
- h) Endangered and threatened plants and animals – All plant and animal species listed under the Endangered Species Act as threatened or endangered that occur on Santa Cruz Island have been evaluated for impacts (See Chapter Four).
- i) Important scientific, archaeological, and other cultural resources, including historic properties listed or eligible for the National Register of Historic Places – Impacts to cultural resources, including an assessment of impacts to properties listed or eligible for the NRHP have been evaluated in Chapter Four – Cultural Resources.
- j) Ecologically critical areas, Wild and Scenic Rivers, or other unique natural resources – Although Santa Cruz Island has many unique natural resources, no resources have status as an ecologically critical area, nor are there any Wild and Scenic Rivers on the island. Impacts to unique natural resources can be found throughout Chapter Four.
- k) Public health and safety – A number of activities proposed in this analysis have the potential to harm the general public. Because of this potential the Park has proposed that the island be closed to the general public during potentially harmful activities to protect public health and safety. These safety

measures can be found in Chapter Four – Human Uses.

- l) Sacred sites – The Park archeologist, through working with the Chumash tribe, has not identified any sacred sites on Santa Cruz Island as defined by EO 13007.

## *Alternatives Considered in Detail*

### ***Features Common to Alternatives 2-4***

#### ***Ecological Monitoring***

Monitoring and assessment of key ecosystem components is an action that is included in all alternatives. Pre-eradication surveys for baseline data of pig damage, flora and fauna abundance and distribution will be conducted. Post-eradication surveys of similar components would be conducted in order to measure ecosystem responses to the eradication of feral pigs and control of invasive species, such as fennel.

#### ***Control of Invasive Plants***

The NPS intends to take action to control invasive plants on Santa Cruz Island regardless of which alternative is chosen. The purpose of weed control is to allow native plant communities to become re-established. If funds are available, the NPS would expand its current efforts to control weedy plants. It is expected that in the long term the extent of the weed problem would be greatest under Alternative One (No Action) and least under Alternatives

Two & Four (Eradicate pigs island-wide). NPS weed control efforts would focus primarily on the NPS-owned portion of Santa Cruz Island. However, the NPS plans to continue to work collaboratively with TNC to address island-wide weed problems.

Eradication of all non-native plants from Santa Cruz Island is not reasonably possible in the short term. Therefore, our goal is to reduce the density and distribution of weedy species sufficiently that it is a minor and non-dominant member of the island plant communities. The primary tool for control of non-native plants is to eliminate non-native animals and to allow native vegetation to recover and displace weedy species. However, there are some invasive weeds that would require focused treatment in order to control

The highest priorities for treatment are highly invasive weeds, outlier populations of weeds, weeds in sensitive habitats, and new invasions. Tools that would be used include digging, mowing, flower/seed head removal, and herbicides. Herbicides would be applied by hand, from a vehicle, or aerially using a helicopter. The herbicides to be used are Glyphosate (Round-up), triclopyr (Garlon 3A), glufosinate (Finale), and chlopyralid (Transline).

Fennel is a particularly high priority species for control because of its current extent and density. Dense stands of fennel would be controlled prior to eradication of pigs. The first priority for fennel control is to eliminate stands where fennel is the dominant plant in the community. These dense fennel stands are both an impact on native vegetation and hinder feral pig eradication efforts. The methods for controlling dense fennel stands is to burn them in the fall/winter of the year and apply Garlon 3A, an herbicide, to the stand in the following two springs. This protocol was developed by The Nature Conservancy in an extensive 600-acre program in the Central Valley of Santa Cruz Island.

Additional treatment of fennel in less dense stands and in outlying populations would be required to ensure that native plant communities do not become gradually overrun by fennel. The NPS and TNC propose to treat these situations by spot burning where appropriate, followed by herbicidal control, and spot treating with differing types of herbicides.

The prescribed burn would be conducted within the limits of a fire plan and prescription that describes both the acceptable range of weather, moisture, fuel, and fire behavior parameters, and the ignition method to achieve the desired effects. The prescribed burn for treating fennel would occur in the fall/winter of the year likely using both hand and aerial ignition.

## ***Alternatives Considered in Detail***

### ***Alternative One - No Action***

Under this alternative NPS would take no action to eradicate feral pigs from Santa Cruz Island or to promote the conservation of rare species, soils, or archeological sites beyond the level of action that the NPS is currently carrying out.

Pigs would continue to occur island-wide and population numbers would fluctuate with environmental conditions. Incidental control of problem animals or focused protection of sensitive resources would occur as staff time and funding permitted.

Weed control would be restricted to current operational levels, which consists of opportunistic removal and spot spraying, but no comprehensive program. Fennel control would not be addressed.

There would be no specific mitigation of impacts, since this action would be a simple continuation of current operations.

#### Monitoring

Monitoring efforts would not change from current NPS levels and would be restricted to measures of community health, listed plant species population health, and vegetation type classifications.

### ***Alternative Two – Simultaneous Island-wide Eradication of Pigs***

Under this alternative the feral pigs would be eradicated from all of Santa Cruz Island. It is unlikely that pigs would be reintroduced to the island because of the distance to the mainland and the relatively low number of people visiting the island on private boats.

The goal would be to accomplish the eradication of feral pigs in a humane manner with as much speed and limited impact to the island as possible. In November 1998 the NPS and TNC assembled a group of biologists and land managers on Santa Cruz Island to discuss the issue of feral pig impacts and recommended management actions. The group unanimously determined that eradication of feral pigs should be of the highest priority for the management agencies due to the pervasive impacts of pigs on natural and cultural resources. The team also determined that an island-wide eradication was an achievable goal.

The eradication of feral pigs would likely be carried out by a combination of agencies or organizations. All personnel involved with this project would follow the mitigation measures described in this document for the protection of resources.

The primary tools for pig eradication would be the use of “walk-in” traps and trained hunters with dogs systematically pursuing pigs on the

ground. Other techniques such as aerial hunting may be used when appropriate.

During the peak period of the pig eradication program it is estimated that a substantial increase in personnel, dogs, vehicles and ATV’s would be on Santa Cruz Island. They would be housed, to the extent possible, in approved government housing on NPS owned property, and TNC facilities including, Central Valley facilities, and West End Facilities. Temporary tent camps may need to be established to facilitate operations in remote areas. Horses may also be used for transportation.

Under Alternative 2 the feral pig eradication project would occur in four phases:

The duration and success of each of the phases would depend on a number of factors, primarily: a) level of funding, b) environmental conditions, and c) pig population numbers.

Table 1: Alternative Two Pig Eradication Phases

Phase	Description
I.	<i>Administration and infrastructure acquisition (Approximately 1 year)</i>
II.	<i>Hunting (Approximately 2 years)</i>
III.	<i>Final Hunting (Approximately 1 year)</i>
IV	<i>Monitoring for Remnant Pigs (Five years)</i>

#### ***Phase I. Administration and Infrastructure Acquisition***

This phase would require approximately one year to complete once funding is received and environmental compliance is met. This year

would be used to hire or contract with personnel, acquire trained pig dogs, purchase supplies and equipment, establish adequate communications on the island, and construct needed infrastructure.

### ***Phase II. Hunting***

A simultaneous island-wide operation would require several teams of hunters and dogs repeatedly working sections of the island. Hunters would be on the island for extended periods of time. Each team would have their own transportation, which could include pick-up trucks, “Jeep” type vehicles, ATV’s, and/or horses to support their operation.

On Santa Cruz Island, ground hunting with dogs is the best general technique for the eradication program (Klinger pers. comm., Lombardo pers. comm.). Helicopter hunting works well in the wet season and along ridges in the winter. Trapping is successful with high densities of pigs and dense vegetation cover. These could be used in areas with “pig highways”, during drought periods, or in fennel stands. Hunting over bait may also be useful in selected situations.

It is expected that the hunting teams would require approximately two years of continuous hunting island-wide to eliminate the pig population on the island.

### ***Phase III: Final hunting***

The final hunting phase begins after hunting teams have made at least three visits to all sections of the island and not seen sign or pigs.

During this phase, which would last one year, a reduced number of hunters and dogs would be maintained on the island. At least two people would be dedicated to searching the island to locate pigs or pig sign. Hunters would respond to the location of pig sign to assist the monitoring team. The project would move to Phase IV after the island had no detectable pig sign.

Monitoring for pig sign would continue throughout the life of the project. The primary purpose of the monitoring is to determine the presence or absence of pigs. Water sources, which are preferred habitat for pigs, would be a focus of the monitoring efforts.

### ***Phase IV: Monitoring***

This Phase would be an intensive period of combing the island to search for pig sign. Hunting teams and dogs would not be maintained on the island any longer. If sign is detected, hunters and dogs would be brought to the island once again. Monitoring would continue for five years following eradication of the presumed “last pig” in order to ensure that remnant pigs do not remain. Long term ecological monitoring to assess ecosystem changed due to pig eradication would continue into the foreseeable future.

### ***Alternative Three - Eradicate Pigs on NPS Property; Exclude Pigs from Selected Sensitive Resources on TNC Property***

Under this alternative the NPS would build and maintain a pig-proof boundary fence. Feral pigs would be eradicated from the 14,000-acre eastern portion of the island. It is expected that pigs would regularly re-enter NPS land by going through breaks in the fence, gates left open, or by going around the ends of the fence. NPS would have an ongoing program to maintain the fence, educate staff and visitors about the need to close gates, and to hunt pigs that get through or around the fence.

The eradication of feral pigs from NPS lands would primarily involve NPS personnel and a contractor. Techniques to be used for eradication would be similar to those described in Alternative 2. Trained hunters and dogs systematically pursuing pigs on the ground and

walk-in traps would be the primary methods used.

Island surveys for archeological sites and listed plant species are largely incomplete. Surveys by resource experts would need to be conducted and sites selected for protection. These selected sensitive resources would then have pig-proof fence constructed around them and pigs would be excluded from these areas. Known occurrences of federally listed plant populations would be fenced. The most important and threatened archeological sites would also be fenced. However, it is highly likely that some of the resources that fall into the category intended for protection would continue to experience degradation by pigs due to the inability to perform exhaustive inventories. Protective fencing would need to be continuously inspected and repaired to minimize damage from pigs.

Additionally, there are many resources of concern that are not formally listed under the Endangered Species Act or not known to be highly significant culturally that would remain vulnerable to impacts by pigs. However, we feel that to attempt to fence all important resources on TNC property is beyond the level of what could be funded or maintained over the long term. Therefore, efforts to exclude pigs from selected areas would be the primary protection for sensitive resources.

### ***Alternative Four – Sequential Island-Wide Eradication by Fenced Zone Hunting***

The directed action of this alternative would result in the complete eradication of feral pigs from Santa Cruz Island. In close coordination with The Nature Conservancy, approximately 45 miles of fence would be constructed, thereby splitting the island into 6 distinct management units of about 12,000 acres each (Figure 3).

Hunting would occur in each of these management units on a sequential, basis. Complete eradication would be achieved in each of the units in a coordinated effort lasting approximately one year using trained, professional hunters. It is the goal of this project to complete this effort in a speedy, humane fashion to reduce prolonged impacts to the island during the eradication campaign. The establishment of fenced zones would allow greater flexibility in the duration of the overall program, however the risk of failure is increased substantially when the program is projected over many years. Mitigation measures dictated within this document would be followed by all personnel involved with the project and would be applied island-wide.

The techniques and tools for achieving the eradication goal would be similar to those described under Alternative Two, and are consistent with other models of eradication such as neighboring Santa Rosa Island, Santa Catalina Island and Hawaii Volcanoes National Park. Trained hunters aided by dogs would seek out and dispatch pigs on the ground, while the establishment of trap lines and sites using live “walk-in traps” would also be used. It is possible that a helicopter would be used to transport hunters or serve as a hunting platform.

This program would necessitate an increase in on-island personnel, jeep or truck style vehicles, all-terrain vehicles, and the use of hunting dogs. Other methods of transportation may also be used, such as horses or helicopters. Housing would utilize existing structures whenever possible, including government approved facilities on NPS owned property, and TNC facilities including, Central Valley facilities, and Christy Ranch. Temporary tent camps may also need to be established to ensure efficient operations in remote areas, such as boat-only accessible anchorages and rough, road-less terrain.



The eradication campaign would occur in four distinct phases, all similar to the phases found under Alternative Two. Each phase has discreet requirements for time to completion. A convened panel of experts has indicated that for the eradication to be successful, hunting must be complete within a ten-year window. If it is not, vegetation recovery from sheep grazing would severely reduce the ability of hunters to eradicate completely. Factors that could influence the duration of the project include but are not limited to: a) committed levels of funding, b) environmental conditions, such as rainfall, and c) pig population numbers. The detailed description of this alternative makes the assumption that sufficient funding would be provided to insure complete eradication.

Table 2: Alternative Four Pig Eradication Phases

Phase	Description
I.	<i>Administration and infrastructure acquisition (Approximately 1 year)</i>
II.	<i>Fencing (Approximately 2 years, overlapping with Phase III)</i>
III.	<i>Hunting (Approximately 6 years, beginning with completion of first fenced zone)</i>
IV	<i>Final Hunting and Monitoring (Five years)</i>

### ***Phase I. Administration, Infrastructure, and Acquisition***

Spanning approximately one year, this phase aims to build appropriate staff to oversee, manage, direct, and carry out the project including fencing and hunting contractors. Additionally, attention would be given to the

infrastructure requirements for project implementation, such as bolstering current housing structures and establishing adequate communications on the island. Necessary equipment and supplies would also be secured at this time.

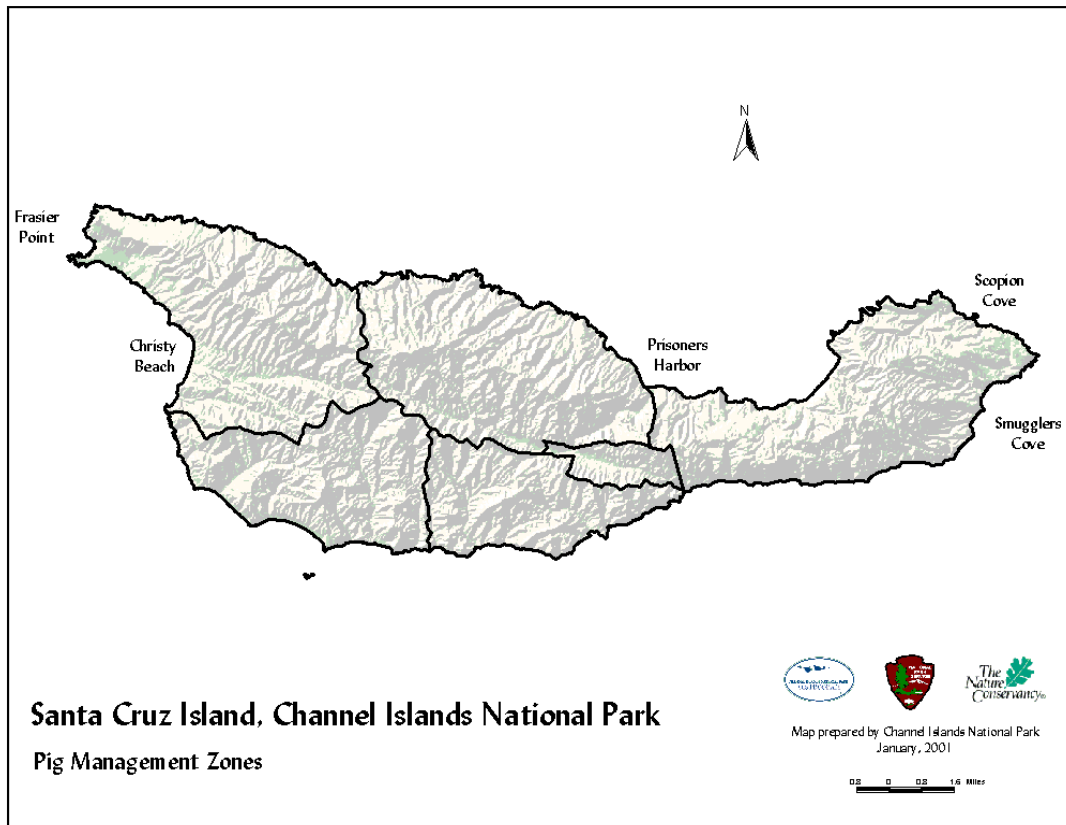
### ***Phase II. Fencing***

If all zones are constructed at once, fencing would require approximately 2 years to complete. The island would be fenced off into 6 distinct management units. Each zone is roughly 12,000 acres in size and designed to be hunted within a one-year time frame, barring factors listed above. Fences would be constructed of either triple-galvanized steel or special alloy metals to resist corrosion in the heavy marine environment of Santa Cruz Island. This type of fence has been demonstrated to be effective and durable in Hawaii Volcanoes National Park's efforts to date. Ideally, fencing would occur across all zones at one time, however, funding and logistics may not allow for all of the fencing to be completed prior to hunting in the zones. For instance, hunting and trapping in a zone may begin as soon as the zone fence is completed, and prior to the next sequential zone fence being completed.

### ***Phase III. Hunting***

Intensive hunting would occur in each of the defined management units as soon as fencing forming the perimeter of the zone is complete. This means that much of the fencing action and the hunting actions would be in operation concurrently. Generally, techniques such as trapping and baiting, as well as ground hunting with dogs have been shown to have the highest efficiency rate for eradication on SCI (Sterner, 1990). Following that model, zonal trapping could precede fence completion and ground hunting in each of the zones. By doing this, a rolling sequence of hunting zones is achieved and efficiency is increased. This reduces the

Figure 3. Alternative Four Hunting Zones for Pig Eradication



risk of failure from vegetation recovery and inability to locate remnant animals.

It is yet to be determined the sequential order of fencing and hunting/trapping for the zones. The factors that would be considered in determining the order of zone eradication activities include: a) risk of failure over time because of vegetation recovery, b) length and separation of defendable perimeter, and c) the need for preparation, such as fennel control within the unit. Continued monitoring of established pig-free zones would occur concurrently with the hunting efforts. Fence patrol for breaks and openings caused by pigs and weather would also be an ongoing task during this phase.

It is expected that the hunting team could achieve a nearly complete eradication status island-wide within a six-year period.

#### ***Phase IV. Final Hunting and Monitoring***

The final phase of the program is perhaps the most important, as the intention is to exhaustively search the island for remnant pigs and pig sign. Hunting teams would no longer be maintained on the island, but would be dispatched to areas if sign or animals were detected. A systematic protocol of monitoring for remnant feral pigs would be developed for the island. Concentrated efforts for monitoring would continue for five years after the completion of the last management zone. Monitoring of the island would continue for five years after elimination of the “last pig” in order to insure success. Long term ecological monitoring to assess ecosystem changes due to pig eradication would continue into the foreseeable future.

## *Alternatives Considered But Dismissed from Detailed Study*

### ***Live capture of feral pigs and relocation to the mainland***

Feral swine, like all animals wild or domestic, are susceptible to a wide range of infectious and parasitic diseases. While some of these diseases are specific only to pigs, others are shared with other animals, including some that are shared with humans.

California is among the top states in the country for numbers of feral pigs. Currently, 52 of California's 58 counties are known to have feral pigs. As a statewide population, the number is great enough to cause substantial ecological impact, property damage, and further the spread of disease. As the numbers and distribution of feral pigs continues to increase, the contact between feral swine and domestic livestock, wild animals, and humans would also increase. This direct or indirect exposure to feral pigs brings with it a greater potential for transmission of both zoonotic (animal to human) and epizootic (animal to animal) diseases. To date, not a great deal of information has been compiled on the diseases of feral swine, let alone the mechanisms or rates of transmission into domestic animals or humans.

Of great interest in feral pig populations nationwide, as well as on Santa Cruz Island are the two diseases Brucellosis and Pseudorabies.

Brucellosis is a bacterial infectious disease of animals and humans that causes abortion and reproductive organ failure in the primary host, which in this case is the feral pig. In secondary hosts, such as humans, it can cause chronic flu-like symptoms, crippling arthritis, or meningitis.

There is no cure for brucellosis for animals, while humans are treated with extremely high doses of antibiotics with the hope of clearing the infection. Brucellosis is transmitted via contact with fluids discharged from the infected animal (nasal mucous, semen, vaginal mucous, etc.).

Pseudorabies virus (PRV) is a herpes simplex epizootic disease that largely affects domestic livestock, cats, and dogs. The disease is spread primarily by direct contact and ingestion of infected tissues or carcasses. The symptoms of PRV vary widely among species, but can include: anorexia, excessive salivation, spasms and convulsions, as well as mad itch. PRV is almost always fatal.

Because of the wide-spread distribution of feral swine and their ability to spread brucellosis to humans and pseudorabies to domestic livestock and pets, federal disease eradication programs set-up for both diseases monitor actions involving feral pigs with grave concern. Millions of dollars have been spent in an effort to rid the United States of these livestock and human plaguing diseases. Therefore, agencies considering management actions that could increase the potential for transmission of these diseases is highly discouraged.

In light of this, both the State of California (1999) and the County of Ventura (1999) oppose transport of any live feral pigs from the island to the mainland. The California Department of Fish and Game stated "The Department would not approve a request to translocate wild pigs from Santa Cruz Island to the mainland. Our reasons for objecting to any plans to translocate wild pigs are two-fold: 1) potential spread of disease to other wild pigs or domestic swine, and 2) increasing the distribution and abundance of an exotic species with great potential of causing damage."

The County of Ventura (Jenks 1999) has stated that it would be "irresponsible to risk the health and welfare" of mainland domestic

livestock and pets by attempting to bring feral pigs from the island to the mainland.

The NPS concurs with this decision, opting to not risk transmission of potentially dangerous and fatal diseases to the mainland populations of domestic livestock, pets, and people.

### ***Use of Poison***

There are a number of toxicants which can be effective as part of an eradication program. However, each of the potential poisons could negatively affect non-target species. It would be very difficult to protect non-targets from incidental poisoning. Additionally, there are rare, endemic species, such as the island fox and spotted skunk, on Santa Cruz Island which would be threatened by increased mortality. For these reasons, and because hunting can achieve the park goal without the secondary impact, poison will not be used as a tool in the eradication of feral pigs from Santa Cruz Island.

### ***Use of Snares***

While snares are an effective and inexpensive method of trapping pigs, the use of snares on Santa Cruz Island would create the potential for capture of non-target animals such as the island fox or spotted skunk. Therefore, snares will not be used in this project.

### ***Use of Contraceptives or Sterilization***

Contraception and/or sterilization could be a relatively benign ways of eliminating feral pigs from an area. Unfortunately, birth control technology is not yet adequate to achieve eradication, or even control, of feral pig populations. The organization *In Defense of Animals* (1999) wrote “Currently there is not

effective sterilization or contraceptives for feral pigs...”

Contraceptives are a tool that work adequately with species with low reproductive rates or animals that can be reliably treated with the contraceptive and booster at the required times and doses. Feral pigs do not meet either of these criteria.

The primary reason why birth control is completely ineffective with pigs is their high reproductive rate. Sows can produce 2 litters of pigs per year and average 5.6 pigs/litter on Santa Cruz Island. Sows begin breeding in their first year. With such a high reproductive rate, even the smallest failure of the contraceptive (the failure rate is approximately 20%) or not delivering the contraceptive and subsequent booster to every sow results in production of a large new generation.

### ***Public hunting on NPS property***

Allowing hunting by members of the public, similar to hunting in National Forests or on certain state lands has been suggested as an inexpensive way to eradicate pigs while raising revenues for the park. The primary reasons why this tool cannot be used as part of the eradication program are: A) there is no legal authority that could allow public hunting to occur in CINP, and B) public hunting, regardless of guide or not, cannot achieve total eradication of feral pigs on the island, a stated goal of this plan.

Recreational hunting can achieve significant control or eradication of animals that have a relatively low reproductive potential. However, animals with high reproductive potentials, such as pigs and rabbits, are much more difficult to eradicate and require a very focused and sustained effort by skilled workers.

Through recreation hunting, the former owners of eastern Santa Cruz Island attempted,

but failed, to control feral sheep numbers low enough to avoid extensive degradation of soils, vegetation and archeological sites on eastern Santa Cruz.

The decision by Channel Islands National Park to not use recreational hunting as a part of its work to eradicate pigs does not preclude The Nature Conservancy from allowing public hunting on its property prior to the eradication.

### ***Use of Swine Diseases***

Diseases, such as hog cholera, can be very effective in the reduction of pig populations. Hog cholera was introduced to Santa Cruz Island in the 1950's. It is thought that this resulted in a reduction of pig numbers on Santa Cruz Island by 75% or more. A survey conducted in the late 1980's confirmed that there is no remnant hog cholera left within the population of feral pigs on Santa Cruz Island.

Hog cholera has been successfully eliminated from the United States and is now classified as a foreign pathogen and disease. As such, hog cholera is not permitted for use in any capacity in the United States.

No swine diseases will be used on Santa Cruz Island because of the possibility of transmission of the pathogen to the domestic livestock, wild animals, or humans on the mainland.

## ***Environmentally Preferred Alternative***

The environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment.

For determining the least damage to the physical environment the Park compared the miles of fence construction across all alternatives. Alternative Two does not require building fence to eradicate pigs from the island. Whereas Alternatives Three and Four require 3+ and 41 miles of fence respectively.

There are similarities in the effects to biological resources for the three action alternatives (Alts 2-4), however, the persistence and duration of these effects is markedly different among the alternatives. For determining the least damage to biological resources the Park compared the duration the biological effects would persist among the alternatives. Alternative Two would complete pig eradication in approximately three years with the bulk of biological effects occurring during these years. Alternatives Three would be an on-going effort with biological effects persisting as long as control/eradication activities are conducted. Alternative Four would have biological affects persisting for up to six years, the lenth of time estimated to eradicate pigs from the island.

Because Alternative Two has less physical disturbance and would be completed in the shortest amount of time (least amount of biological effects) it is determined to be the "Environmentally Preferred Alternative."

## Comparison of Alternatives

Table 3. Comparison of Alternatives

	<i>Alternative One</i>	<i>Alternative Two</i>	<i>Alternative Three</i>	<i>Alternative Four</i>
<i>Pig Eradication Strategy</i>	No Eradication Strategy would be implemented	Hunt all areas simultaneously until all pigs are eradicated	Create two pig zones: eradicate pigs in NPS zone; exclude pigs from selected resources on TNC property	Hunt and trap pigs by zone until all pigs are eradicated
<i>Fence Construction (miles)</i>	None	None	~10	~45
<i>Duration of Project</i>	0	4 years of eradication, 5 years inspect and monitor	2 years of eradication, exclude forever	6 years of eradication, 5 years inspect and monitor
<i>Fennel Control</i>	None	Prior to pig eradication - Burn Fennel in the fall; aerially spray with herbicide two consecutive springs	Prior to pig eradication - Burn Fennel in the fall; aerially spray with herbicide two consecutive springs	Prior to pig eradication - Burn Fennel in the fall; aerially spray with herbicide two consecutive springs
<i>Likelihood of Success</i>	None	Medium/High	Low	High